NASA TECH BRIEF

Ames Research Center

Fabrication of Large Ceramic Electrolyte Disks

The problem:

To produce a number of large ceramic disks for use as electrolytes in high-temperature electrolytic cells; homogeneity and constancy of density are prime desiderata.

The solution:

A carefully controlled process for sintering compressed ceramic powders.

How it's done:

The composition of the ceramic disk is controlled by using a mixture that contains various amounts of submicron powders of pure ingredients; for example, a composition corresponding to $(ZrO_2)_{0.92}(Sc_2O_3)_{0.08}$ is made from appropriate amounts of zirconia and scandia.

Approximately 400 grams of prepared powder are loaded into a die and cold pressed at about 9,000 kg (10 tons) total load. The die is a piece of graphite with a bore 63.5 mm in diameter in a body 88.9 mm in diameter and about 228 mm long. Two graphite pistons are used to compress the powder.

The die (completely assembled and with the compressed powder in it) is then transferred to an arrangement that permits evacuation of the sample while it is simultaneously heated and compressed. Following a preliminary evacuation, ram pressure is applied at room temperature and the furnace is heated slowly to outgas the powder. Then the heating rate is increased to about 20° per minute while the desired pressure level is maintained (about 10,000 kg of total force). Since the powder increases in volume, the total applied force must be decreased until the temperature is in the range of 1200° to 1700°K, when the volume of the powder shrinks because of sintering and rapid increases in density; the maximum total applied force is maintained until the required temperature is achieved. Additional densification of the powder is obtained by maintaining a "soaking" temperature for a period of time; since the pressure tends to increase during the soaking period, it is necessary to reduce the force applied by the press. Then the pressure is released.

Following another soak period, the temperature is reduced at the rate of about 10° per minute.

Thin, strain-free uniformly dense disks as large as 30 cm^2 have been fabricated by slicing ceramic slugs produced by this technique.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
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Reference: B72-10202

Patent status:

No patent action is contemplated by NASA.

Source: Stanley A. Ring of
Applied Electrochemistry, Inc.
under contract to
Ames Research Center
(ARC-10320)

Category 03